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THE HUMAN FACTOR IN THE DESIGN AND
LAYOUT OF SUBMARINE EQUIPMENT

The Kollmorgen Any-Height Periscope

151-1-7

Contract N6-ori-151, Project Therblig (Project 20-F-2)

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No. 17.

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Report prepared by:

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THE HUMAN FACTOR IN THE DESIGN AND
LAYOUT OF SUBMARINE EQUIPMENT

Progress Report No. 9: The Kollmorgen Any-Height Periscope

In accordance with previous arrangements, the specifications for the submarine attack periscope, fixed eye piece type (type VI), have been examined. Particular attention has been given to the controls and displays from the standpoint of human operation.

This report presents, for the most part, comments about each control and indicator as established by the Bureau of Ships, and a rough sketch is included indicating one possible arrangement. It is recognized that some of the suggestions may not be feasible because of engineering requirements and that others may also be invalidated because of operating procedures.

A previous report (THE HUMAN FACTOR IN THE DESIGN AND LAYOUT OF SUBMARINE EQUIPMENT, Kollmorgen Any Height Periscope, human factors in the operation of, Contract N6-ori-151, Project Therblig (20-F-2), Progress Report No. 7) contained certain criticisms and suggestions of the preliminary design of the Kollmorgen Any Height Periscope. It is believed that certain of these suggestions are still applicable and therefore will be repeated.

In view of the limited area for the operation of this instrument and the work load which of necessity must be borne by the Captain, it appears that the number of personnel should be limited to two: an observer and an assistant. Bureau of Ships has suggested that the assistant be stationed behind the observer. However, it would appear to be more convenient if the assistant were stationed to the right of the observer, where he might more easily operate some of the controls. Therefore, in placing the controls, it has been assumed that two operators will be used and that the assistant will be stationed to the right of the observer.

a. Hoist-Lower control:

Since the Bureau of Ships specifies that this may be a foot operated control, such a control is recommended. However, it probably should consist of two push-buttons or pedals, one to raise, and one to lower. This would allow a resting position of the foot on the deck when not activating the device. It must be remembered that the periscope is to be designed for seated or standing operation.

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b. Training handles:

The use of conventional types of training handles has been agreed upon. They should be located at a height of 4 feet from the deck approximately 6" back of the eye piece, and approximately 11" right and left of the median line of the body. Arm supports should be provided.

c. Power change control:

Conventionally operated by rotation of right training handle, with indicator marks showing LP and HP.

d. Prism tilt control (altiscope):

Conventionally operated by rotation of left training handle. Bureau of Ships specifications call for click and feel indications at 0° and each 8° above and below 0° throughout the range. In using quantitative scales or indicators, it has been found that multiples of five or ten degrees are more convenient. Unless there is some specific reason for indicating each eight degrees of tilt, it is suggested that multiples of five or preferably ten degrees be used.

e. Focussing adjustment:

The present system of a fluted ring around the eye-piece appears to be highly satisfactory.

f. Ray filter selector (visual):

A six position selector switch is suggested, permitting selection of the neutral filter as well as the five color filters. It should be a fluted knob, located below and to the left of the eye piece.

g. Camera start-stop push button control:

Located on right training handle.

h. Still or movie camera selector:

A three position selector switch permitting use of still camera, movie camera, or assistant's viewer. It should be a fluted knob, located in upper right area of the eye piece stand, together with the other camera controls.

i. Variable density filter selector (combined with f).

j. Variable density filter operator:

Should be superimposed on the visual filter selector. This should be a milled knob to distinguish it from the filter selector, and should be smaller in diameter. Since this may have to be used while observing, it is suggested that this combined control be located below and to the left of the eyepiece for most convenient operation.

k. Checkers eye piece selector control:

This has been combined with (h).

l. Stadimeter selector:

A toggle switch in lower right area of eye piece stand. When in up position, the stadimeter is visible in the optical field.

m. Stadimeter operator:

Milled knob located in lower right section. Clockwise movement will decrease distance between images; counter clockwise will increase distances between images.

n. Mast-head height setting controls:

Bureau of Ships recommends a hand wheel for setting in mast-head height. Consideration should be given to the use of a combined knob and indicating dial for performing this function. It is located in lower right area; but above the other stadimeter controls, so that the indicating dial is at a convenient height for observing.

o. Binocular eye piece:

Should be so installed that monocular and binocular vision can be attained by operating a simple selector switch located above the eye piece.

p. Binocular interocular distance adjustment:

Should be located above and between the two eye pieces. Use of a milled knob is recommended.

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q-r. Telemeter illumination control and switch:

Combined into one control so that with clockwise rotation the illumination is switched on with a click to the minimum acceptable brightness and that further rotation increases the brightness. Use of a milled knob is suggested.

s. Eyepiece illumination control and switch:

Located adjacent to telemeter illumination control and operates in a similar manner. Should be smooth to distinguish it from the telemeter illumination control.

t. Camera ray filters:

Four-position fluted selector switch, located in upper right area with other camera controls.

u. Photo exposure control:

Located in upper right area. Knob and dial to set exposure time and frames per second.

v. Bearing input switch:

Push-button located above left training handle.

w. Range input switch:

Push-button located under left training handle.

x. Bearing mark buttons:

Located conventionally on left training handle.

y. Camera and viewer focussing control:

Milled knob located in upper right area.

z. Height indicating switch:

A two-position selector switch located in lower left area.

z'. Desiccator:

Control to be operated by left foot.

Z*. Relative to true bearing switch:

Two-position selector switch, located on left side, above bearing input switch.

The following indicators should be available to observer or assistant:

a) Periscope Height-above-shears indicator:

1. In optical field (this can be switched to show height-above-water)
2. Mechanical height indicator:

The mechanical indicator should be located on the right side, so as to be available to the assistant. A simple dial presentation, marked in feet, would be the most effective. Therefore, unless it is necessary that a tape be used, a dial is suggested.

b) Camera exposure counter, still camera:

Counter, visible through camera access door.

c) Camera footage counter, movie camera:

Counter visible through camera access door.

d) Viewer, with focussing control:

This should be placed at right angles to the eye piece, at the right side of the eye piece box so that it may be observed by the assistant. The focussing knob has been discussed above.

e) Periscope "Power-on" lights:

Red light in upper right area.

f) Range indicator:

Drum in lower right area.

The above comments relate to all the controls and indicators listed on page 27 of the Bureau of Ships specifications, and include two or three other controls which are added where needed. The enclosed sketch represents a proposed arrangement in which the controls are grouped according to function and operator, and in which adjacent controls are distinguishable by shape.

The recommendations made here are based on general results of experiments on equipment design. However, before controls are finally placed on the periscope, it would be desirable to construct a mock-up in which the proposed locations, shapes, and types of controls might be validated by specific tests.

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- (a) Hoist-lower control
- (b) Training handles
- (c) Power-change control
- (d) Prism tilt control
- (e) Focussing adjustment
- (g) Camera Start-stop control pushbutton
- (h) Still-movie camera selector (including checker's eye piece selector)
- (j) Visual ray filter selector and variable density filter operator
- (l) Stadimeter selector
- (m) Stadimeter operator
- (n) Masthead height setting control
- (o) Binocular eye piece
- (o') Monocular-binocular selector
- (p) Binocular interocular-distance adjustment
- (q) Telemeter illumination control
- (r) Telemeter illumination switch
- (s) Eyepiece illumination control
- (t) Camera ray filter control
- (u) Photograph exposure control
- (v) Bearing input switch
- (w) Range-input switch
- (x) Bearing "mark" button
- (y) Camera and viewer focussing control
- (z) Height indicating switch
- (z') Desiccator
- (z*) Relative-True Bearing switch

- (a') Periscope height-above-shears indicator
- (d') Viewer
- (e') Periscope "Power On" light
- (f') Range indicator

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